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# HEARING LOSS

## *hope through research*

### **Many people have hearing disorders**

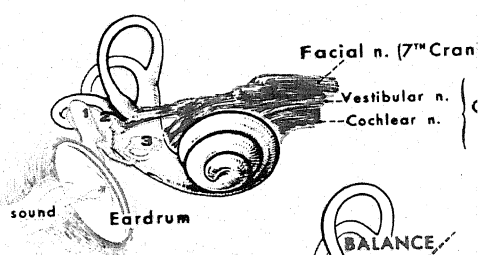
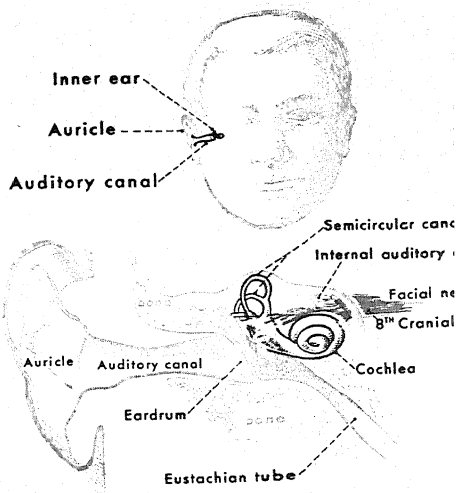
Impaired hearing is one of the leading causes of chronic disability. With many, it is a serious disability. Of the more than 8 million Americans with hearing impairment in one or both ears, some 236,000 cannot hear and understand spoken words. For everyday living needs, their sense of hearing does not work. In laymen's terms, these people are "deaf." Of course, thousands more suffer from less severe degrees of hearing loss.

These figures are based on household interviews by the National Center for Health Statistics of the Department of Health, Education, and Welfare.

About one million American children, including some who are too young to be in school, have a significant handicap in hearing, according to an estimate based on a survey of children in one large city.

The proportion of people with a hearing disorder is almost certainly increasing because doctors are learning how to save more and more of the babies who have difficult births or are born prematurely. Some of these babies have defective hearing.

Also, more and more of us are being exposed to extremely loud noise, and more and more of us are

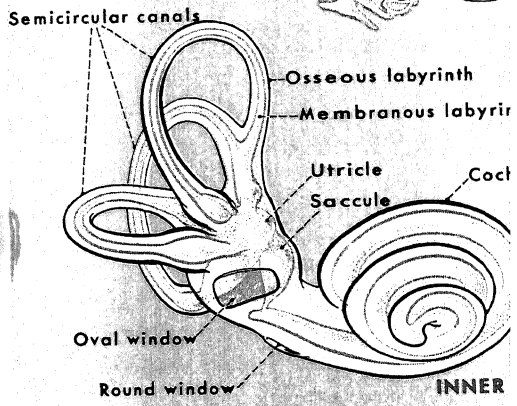


MIDDLE EAR BONES

1 hammer

2 anvil

3 stapes (stirrup)



living into the older ages during which impaired hearing has always been most common. Yet, because of the flow of research progress in hearing disorders—the progress in prevention, in earlier diagnosis, and in improved treatment—the present is a more fortunate time for the hard-of-hearing person to live in, and the future looks increasingly bright.

The earlier threatened hearing trouble is found, the greater the likelihood of handling it successfully. However, even when a hearing impairment has existed for many years, professional attention sometimes leads to marked improvement.

## How we hear

Sound waves pass through the ear (auditory) canal and beat against the eardrum, causing vibrations in the chain of three small bones in the middle ear. The third bone, called the *stapes* (pronounced STAY-pee-z), or stirrup, is the smallest bone in the human body. It fits into the oval window between the middle ear and the inner ear. When the stapes moves, fluid in the inner ear carries the vibrations into the canal of a delicate, spiral structure, the *cochlea* (which means snail shell).

Thousands of sensory cells in one part of the cochlea are connected to fibers that make up the cochlear nerve (nerve of hearing). Each sensory (receptor) cell has many microscopic hairs at one end. Movements of the fluid, with the aid of an overlying membrane, bend these tiny hairs. Movement of the hairs stimulates the hair cells to generate electrical impulses, which are carried up the cochlear nerve to the brain.

In short, the ear changes sound waves into electrical nerve signals to which the brain gives meaning.

The smallness of the structures contributes to the difficulty of research on details of the hearing process. The three little bones of the middle ear, for example, could be held on the tip of your little finger. The whole middle ear is about as big as a string bean seed (about three-sixteenths of an inch by three-eighths of an inch). The cochlea of the inner ear is even smaller than the middle ear.

However, the modern development of the electron microscope allows the research study of ear structures at practical magnifications up to an amazing 100,000 times. Furthermore, the ear surgeon now can use an operating microscope which enlarges his view of the tiny structures as much as 60 times.

### Main types of hearing loss: conductive, sensori-neural, and central

When sound waves are not conducted adequately to the inner ear, all sounds seem to be muffled, and the person's hearing loss is called *conductive*. The cause may be an obstruction in the auditory canal—an accumulation of wax, perhaps, or a blockade caused by swelling and pus.

Occasionally, with children, doctors find a marble or a bean, and not rarely, with adults, a forgotten wad of cotton. (Only on direct orders from your doctor should you ever put cotton in the ear, and only then a large piece that cannot possibly get lost in the ear canal.)

Much more commonly the trouble in conductive hearing loss occurs in the middle ear, and again swelling and pus are one cause of hearing loss. The principal types of middle-ear trouble are discussed later in this pamphlet.

If sound waves do reach the inner ear but are not properly converted into a message that can be passed on to the brain, the loss is called *sensori-neural* (sensory-neural) or neurosensory. Other terms are *nerve deafness* and *perceptive deafness*. A person with such a loss generally hears low-pitched tones better than high ones. Sounds are often distorted.

Many persons with poor hearing have a *mixed* loss—a combination of conductive and sensori-neural impairments.

Sometimes the trouble lies beyond the ear. The signals from the ear may not be reaching the brain because of trouble along the cochlear nerve, or the brain may not be properly interpreting them. Persons affected in such a way are said to have a *central* hearing loss. They may hear speech but have difficulty understanding it.

## More about nerve deafness

Nerve deafness (sensori-neural hearing loss) can occur at any age from conception to the oldest years. If it is partial, a hearing aid may offer great assistance, especially to babies who should be learning language through listening to speech. A total hearing loss is rare, but in such cases hearing aids are useless. However, particularly in elderly persons, the hearing problem may involve "understanding" rather than volume of sound, and hearing aids may not help. Do have an examination and advice from an M.D. who is an ear specialist before considering a hearing aid.

For most kinds of nerve deafness, resulting from such causes as infections, noise, heredity, or a blow on the ear, prevention but not cure is possible.

Hearing loss from sensitivity to certain medicines or other irritants may be controlled by stopping their use. Active research both on the inner ear and on aging throughout the body may contribute directly to means of avoiding hearing loss due to nerve damage in the later years.



## Research progress against deafness in the newborn

German measles during the early weeks of pregnancy can cause deafness, blindness, and mental retardation in the unborn child. Later in pregnancy, minor

damage to the child has been proved. A research success is the German measles (rubella) vaccine. This vaccine is strongly recommended for all boys and girls between the ages of 1 year and puberty. This could eliminate the source of German measles which threatens a pregnant woman's unborn child.

Routine blood samples from 60,000 pregnant women studied in a Collaborative Perinatal Research Project of the National Institute of Neurological Diseases and Stroke (NINDS) helped define the gravity of rubella. NINDS is one of the National Institutes of Health, the Government's main agency of biomedical research, communication of biomedical knowledge, and education for the health professions.

Another source of danger to the hearing nerves of an unborn baby is a blood conflict with the mother. Rh-negative mothers may become sensitized to Rh-positive blood from having an Rh-positive baby, an Rh-positive miscarriage, or an accidental Rh-positive blood transfusion. All Rh-negative mothers not previously sensitized should receive an injection of a special serum within 72 hours after each birth of an Rh-positive baby or an Rh-positive or unknown-type miscarriage. Rh immune globulin, according to research reports, if injected during this 72-hour period, will almost always protect any future children from "Rh-disease."

The preparation is useful only for differences in Rh type, and not ABO or other blood incompatibilities.

The preparation is a serum, not a vaccine. Its protective value is not permanent, so that it must be used after each Rh-positive baby or Rh-positive or unknown-type miscarriage of an unsensitized mother. According to present knowledge, the preparation apparently does not help the estimated 30,000 Rh-negative mothers already permanently sensitized to Rh-positive babies.

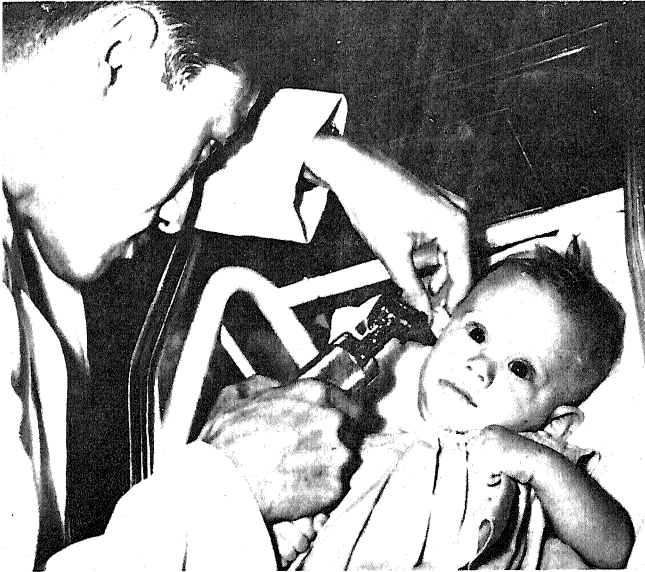
A most important step a mother can take to ensure her baby's health is to see her doctor as soon as she thinks she is pregnant.

When a baby *is* born with defective hearing, the situation is hopeful because of the clinics, hearing centers, preschool programs, classes, and schools that now stand ready to help such a child and his family.

## **When is deafness inherited?**

When deafness "runs in the family," a geneticist who takes a complete family history can advise a couple as to the risk of having a deaf child. Not all hearing impairment in the newborn is inherited; it might be caused by such an event during pregnancy as German measles in the mother.

Sometimes a family tendency to hearing loss does not appear until adulthood or middle life.



## **Tests of hearing for the very young**

Authorities on loss of hearing at one of our medical schools tried out a preliminary hearing test developed especially for babies.

While the baby being tested sat on his mother's lap, someone in front waved a toy. Then someone in back made a noise with a bell, then a rattle, and the baby's responses were noted.

If a baby's hearing is normal, the way he responds depends largely on his age. By the time he is four months old, he is likely to be more interested in the human voice than in other sounds. At eight months, it is normal for him to turn both his head and his body in the direction from which a sound comes.



Out of hundreds of babies tested at the medical school, a significant number did not respond normally.

After such screening tests, more exacting tests of babies' and children's hearing are made by ear specialists on those in whom hearing loss is suspected.

Kathleen is an example of today's hopefulness. When her hearing impairment had been carefully evaluated, she began wearing a hearing aid for short periods even before she was a year old. The sounds delighted her. Her parents helped by talking to her, playing music, and showing their pleasure whenever the baby uttered a sound.

Children wear a body harness under dress or shirt to hold the microphone and amplifier.



Later she went to one of the many fine classes in speechreading and auditory training. Eventually she could keep up with regular school classes. Had her family lived where special classes were not available, she might have gone to one of the more than 80 residential schools for those with a severe hearing impairment or deafness.

## The importance of finding the trouble early

Detecting impaired hearing soon after it occurs and doing something about it are important at any age. Everyone has noticed how the speech of a person who is losing his hearing is likely to change for the worse.

But in babies who should be learning speech, the effect of lack of hearing on speech and language is crucial. Normally, speech develops as a direct result of hearing. *Speech* is both a way of making the sounds we call words, and a system of symbols which stand for something. *Language* is the system of symbols which uses words to represent objects, actions, ideas, meanings. So the little child who cannot hear, or hears poorly, is doubly handicapped: he has difficulty acquiring the meanings for which language stands as well as difficulty in talking. The earlier in life that he is given any corrective treatment, or learns to use a hearing aid if indicated, and the earlier he receives special education, the faster will his learning proceed, and the happier will he and his family be.

This special education has to fit his special hearing problem, which leads right back to the need for early testing, to help pinpoint the type of hearing impairment. For example, a complete ear examination by specialists in the field, probably including an otologist and an audiologist, sometimes reveals that lack of hearing is not a problem in the ears, but may be a brain-centered difficulty. The kind of education given such children has to be different from that for other children with hearing impairment.

## Hearing losses during childhood

Such common diseases of childhood as measles, German measles, scarlet fever, whooping cough, and mumps can lead to impaired hearing of the sensorineural type. So can other virus infections and meningitis.

The most common cause of childhood hearing loss, however, is inflammation of the middle ear, known as *otitis media*. If Johnny comes down with a cold and complains that his ear bothers him, the chances are he has an earache from *otitis media*.

His eardrum may break from pressure of fluid lecting in his middle ear, causing a "running ear" a partial hearing loss. When the eardrum is close nature or a plastic operation, the hearing may b stored to normal.

Johnny's earache needs prompt medical care by family doctor, a pediatrician, or a specialist in orders of the ears called an otologist or otolaryngist. There is danger that bacteria will work their into the mastoid bone and set up an infection lea to lasting damage in the middle ear, severe illness even death from meningitis. Bacteria-killing d taken by mouth often bring relief quickly.

A child who has had a middle ear infection, h ever, should have medical followup as long as doctor advises, since the relief of pain does not n sarily mean that the trouble has been completely c. Even with today's drugs, the doctor may have to c the eardrum and drain the accumulated fluid in o to relieve the pressure or to clear up a lingering i tion before it becomes chronic. This is a minor cedure and the eardrum typically heals quickly without loss of hearing. As a matter of fact, the less chance of a hearing loss after proper surg drainage than without it.

### **Guarding a child's hearing**

A complete immunization program for infants children helps preserve hearing. Hearing tests sho be a part of a child's annual physical checkup. T ically, many children have been considered ment retarded until hearing tests proved that deafness their real problem.

Because 4-year-old Bill scarcely ever did what was told, his father called him "bad" and "stupid" and his mother took him to a psychiatric clinic. his basic trouble, tests showed, was a hearing l severe in one ear and moderate in the other.

Bill now goes to kindergarten in a special school that he can get intensive help in using his hearing and in speaking intelligibly.

Mason's earaches were controlled by antibiotics several occasions. When he entered first grade,

Reading Readiness test scored nign. But he didn't learn; he didn't mind unless the teacher spoke angrily to him. Teachers and parents were frustrated. Was he mentally retarded, or disturbed? Fortunately, a screening test of first graders' hearing revealed the unrecognized hearing loss which was causing Mason's troubles.

An ear specialist corrected the accumulation of fluid in Mason's ears which was causing the severe hearing loss. He changed at once to a bright, well-behaved student. A personal tragedy had been corrected.

If your youngster seems inattentive, or leads you in other ways to suspect a hearing loss, get medical advice. Get medical advice, too, if his ears seem to bother him during a cold, or if he has frequent colds. At times the family doctor or an otologist will find that the adenoids should be removed in order to prevent permanent interference with the functions of the eustachian tube and, therefore, the middle ear.

(The function of the eustachian tube is to connect the middle ear with the throat in order to equalize pressure on each side of the eardrum. In addition to blocking by adenoids or tumor tissue, the tube can be closed by swelling from allergy or infection, or by a rapid change of height as in flying or driving in the mountains. Closing the tube from any cause can interfere with hearing or even damage it. Swallowing or yawning helps to reopen a temporarily blocked tube. If this is not effective, see your physician.)

### **Otitis media and otosclerosis in adults**

Among people in their twenties and thirties, otitis media is a major cause of hearing loss and needs the same prompt, thorough care as when it occurs in children.

Otosclerosis is another important trouble-maker, particularly during young adulthood and even during the teens. In this condition, new bone starts growing on parts of the bony capsule in which the organ of hearing lies. Generally, it never causes trouble, but in about ten persons out of 100 with this condition, it anchors the stapes and prevents this tiny bone from properly transmitting sound waves to the inner ear.

Spectacular advances have occurred in the treatment

of hearing impairment caused by otosclerosis. More needs to be known about the cause and prevention of otosclerosis.

### **Danger from noise damage multiplies**

The damage or "traumatic" level of noise depends upon two factors: An extremely loud noise heard once only, such as an explosion close to the ears, may cause sudden temporary or permanent nerve deafness. Or, a lesser noise, repeated for months, or years, may cause gradually increasing nerve deafness.

As our civilization has become noisier, cases of hearing loss have increased among bus and cab drivers, road builders, traffic policemen, hunters, servicemen, farm tractor drivers, and factory workers. This loss is sensori-neural; examination of ears after death shows that part of the cochlea has broken down.

The hearing of teen-agers or others who spend hours in a room with loudly amplified music may be damaged. A housewife who runs many noisy appliances in her kitchen at one time might be wise to work in another room till the noise is over. Any noise which requires raising the voice to be heard is a threat to hearing if prolonged.

A research center established by the Subcommittee on Noise of the Committee on Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology devotes full time to the problem of noise in industry. Some of the investigations are financed by NINDS.

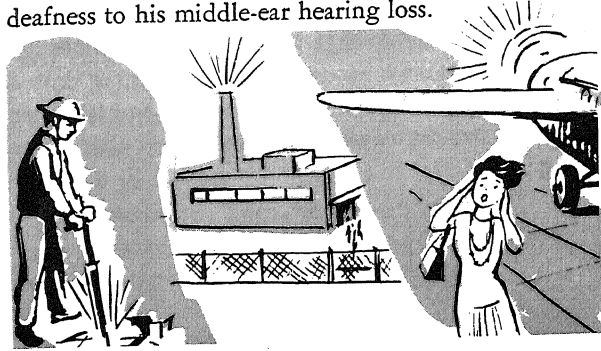
The intensity of sound, as determined by the pressure of sound waves, is measured by a unit called the decibel. In a fairly quiet office, the noise level measured this way is about 60 decibels; in heavy traffic, about 80. (To the ear, the traffic noise will sound about 4 times as loud as the office noise.) Close to a jet engine, the intensity is about 140 decibels, which is the point at which noise becomes painful.

Recent research suggests that if the sound level is expected to go as high as 85 decibels in certain "octave bands" for as long as 5 hours a day, for several years, measures should be taken to conserve the workers' hearing. These measures should include rest periods

away from the noise, so that the ears can recuperate, and the use of ear plugs or muffs.

Since noise first affects a person's ability to hear extremely high tones, which do not occur in conversation, the loss generally goes unnoticed until the loss affects the speech range. Conservation measures, therefore, should also include tests that point to people who are beginning to develop a loss.

A person with a conductive middle-ear hearing loss should be advised not to work in noisy surroundings. Noise damage may add an incurable inner-ear nerve deafness to his middle-ear hearing loss.



### **Avoiding other ear injuries**

In a healthy ear, protective wax is secreted by glands in the ear canal. Excess wax may at times form a partially deafening plug.

If this happens, don't gouge with a match, hairpin, or other sharp instrument. It has been said wisely, "Never put anything smaller than your thumb into the ear canal." You may scratch the skin of the ear canal and cause infection, or jam the wax against the drum, increase discomfort, and even rupture the drum.

One research survey showed that wax completely covered the eardrums of both ears in one out of every 8 persons examined. This is a wasteful, unnecessary loss of hearing. In your regular physical examination, be sure that your doctor looks at your eardrums and if you or your family has any suspicion that your hearing has failed a little, ask him to refer you to an ear specialist.

If an insect flies into the ear canal, drown it with a little clean cooking or baby oil.

To avoid driving mucus from a head cold or sinus

drainage into the eustachian tubes where it may infect the ears, blow the nose gently, with both nostrils open.

Caps or ear plugs worn while swimming only partly protect the ears. Harmful organisms in contaminated water still can enter the eustachian tubes through the nose and mouth. Diving sends a rush of water up into the nose, carrying with it germs from the nose and throat or from the water. From the nose this water may easily be forced into the ear through the eustachian tube.

While swimming, it is dangerous to blow the nose forcefully or to attempt to "blow" water out of the ears, as this may damage the ears. If water does not run out of its own accord, lie on the ear, or drop a little rubbing alcohol into the ear canal and let it run out. See your doctor about any ear trouble after swimming.



### Advancing age and hearing loss; presbycusis

The term *presbycusis*—from Greek words meaning "old" and "hearing"—often is used for hearing impairment first noticed after 60 years of age. In one research study of the various kinds of hearing loss, presbycusis accounted for 16 percent.

The higher tones frequently begin to fade during the thirties and continue to fade as the years go by, while the tones necessary to understand speech may show no great change for decades. Unless something

besides age is at work, many of us will be in our seventies before we notice that our hearing is less acute, and some of us will live into the eighties and nineties without noticeable loss.

Presbycusis once was believed to be due to disintegration of cells in the cochlea of the inner ear. An NINDS grantee reported that, on the contrary, changes with aging of the brain appear to be primarily responsible for this type of hearing loss.

### Some other causes of hearing loss

Other factors responsible for hearing losses include:

- Blows on the ear, which create intense pressure and may rupture the eardrum, shake the hearing bones loose, and damage the cochlea.
- Skull fractures and tumors. See end of pamphlet, *Dizziness including Meniere's Disease, Hope through Research*.
- Certain medicines. These include quinine in individuals sensitive to it, and a few antibiotics, in particular kanamycin and dihydrostreptomycin.
- Virus infections.
- A condition called Meniere's disease, which is marked by dizziness and nausea as well as by impaired hearing and ringing in the ears. (The inner ear contains not only the cochlea but also the mechanism for maintaining our balance—called the vestibular apparatus and including the semicircular canals.) See end of text for information on pamphlet, *Dizziness, including Meniere's Disease, Hope through Research*.
- Radiation exposure.

Also, since the hearing apparatus, like the rest of the body, must be adequately nourished and receive sufficient oxygen in order to work properly, there is reason to think that reductions or stoppages of the blood supply to the inner ear may be causes of hearing loss. These could result from hardening of the arteries, hemorrhages, blood clots, or changes in very small blood vessels.

One study of hospital patients with a hearing loss found that a number of them had other ailments also. Among these other disorders were diabetes, allergies, syphilis, pulmonary tuberculosis, arterio-



sclerosis, and emotional disturbances. These may cause a hearing impairment or make an existing impairment worse.

For this reason, a complete physical examination by the family doctor or pediatrician is a sensible first step, to rule out or treat such possible causes of hearing loss before specific testing of hearing begins.

### **Specialists, hearing centers, and hearing tests**

An *otologist* is a specialist in diagnosis and treatment of the ear. He has an M.D. degree.

An *otolaryngologist* is an M.D. who specializes in care of the nose and throat as well as the ear.

An *audiologist* is a specialist in the non-medical evaluation and rehabilitation of persons with hearing disorders. He generally has an M.A. or a Ph. D. degree.

The growing numbers of centers or clinics devoted to hearing troubles are enabling many more Americans to find help with their hearing loss problems. Some of the hearing centers do not have a physician (M.D.) on the staff: their audiologists give hearing tests to find out the hearing levels and the types of impairment; then the centers report back to the family doctors or otologists who have sent the patients to them. Some centers have otologists on the staff. Many centers offer rehabilitative services, such as help in selecting and using a hearing aid.

Alice James' husband complained that she turned the television up too high. She herself noticed that she often had to ask people to repeat.

At a hearing center, an audiologist seated Mrs. James in a soundproof room with a window and showed her how to adjust an earphone. He then sat down at a desk outside the window and turned dials to operate an audiometer, a device for measuring hearing.

Each time the audiologist turned a dial, a tone passed along the wire leading to the earphone and grew louder until Mrs. James signalled that she heard it. (The testing may begin with loud sounds and progress to softer ones until nothing can be heard.) At the end, the audiologist had an audiogram, or



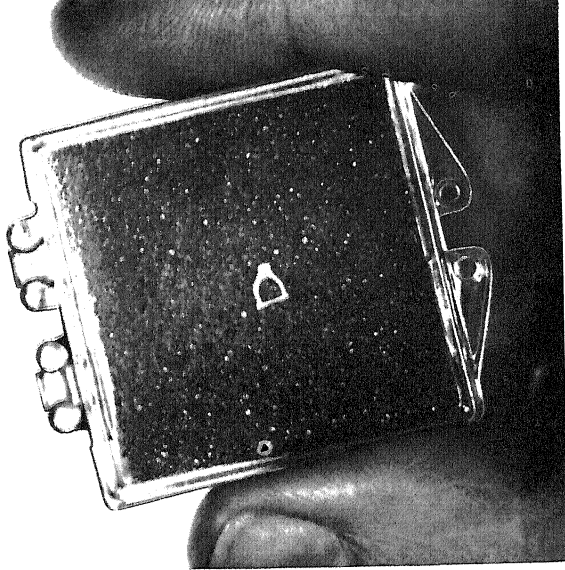
record, of Mrs. James' hearing loss.

Then Mrs. James was given a different kind of receiver, a tiny vibrator held against the bone right behind her ear. Sound waves travel along this bone to the inner ear and can be heard if the cochlea and the cochlear nerve or its central nervous system connections have not been affected. When the bone-conducted sounds are heard better than those conducted through the eardrum and the middle ear in the usual way, the person has a conductive loss.

As in Mrs. James' case, a hearing test helps to indicate the type of trouble. For example, fluid in the middle ear usually hinders the hearing of high tones more than low. So if the loss is conductive and quite mild for low tones and more severe for high, the otologist suspects a middle-ear infection, with fluid. On the contrary, if the conductive loss is quite mild for high tones and more severe for low, he suspects an early case of otosclerosis. But a careful medical history and inspection are necessary before an exact diagnosis can be made.

One of several newer tests is concerned with a person's response to sounds of various degrees of loudness. If loud sounds appear normally or abnormally loud while others are heard dimly or not at all, the trouble is sensori-neural and probably lies in the cochlea. Such a test helps rule out the possibility that either the cochlear nerve or the hearing center of the brain has been affected.

Another test uses a tape recording of somebody talking. The record sounds distorted because some of the frequencies used in conversation have been



The stapes is the smallest human bone, and must vibrate to carry sound waves to the nerve of hearing.

filtered out. Mrs. James, because she had normal brain function, could grasp much of this kind of talk; those with tumors or other conditions interfering with the brain may not be able to.

### **Surgery for otosclerosis**

On the basis of medical examination, audiogram, and family history, Mrs. James' otologist diagnosed her trouble as otosclerosis. "People like you are excellent candidates for hearing aids," he told her, "and men are excellent candidates for surgical treatment, too." She decided to have an operation.

Surgery for hearing losses caused by otosclerosis was tried as long ago as 1876 and in some cases was successful. Many developments were necessary, though, before it could be widely used.

Operations with sterile techniques, antibiotics, and other means of preventing or controlling infection have provided one great advance. Another has been the operating microscope, which, by enlarging objects as much as 60 times, enables the ear surgeon to see the tiny space within which has been the information of ear structures and

from work with animals.

Mrs. James' surgeon used the type of operation generally called *stapedectomy*. He lifted up the eardrum and found that the third little bone, the stapes, was firmly fixed in the oval window leading to the inner ear. So he carefully removed the stapes and then covered the oval window with a bit of fat taken from the ear lobe. (Sometimes other substances are used.) Next he rebuilt the sound-conducting apparatus by replacing the stapes with a metal wire. (Other methods are used.)

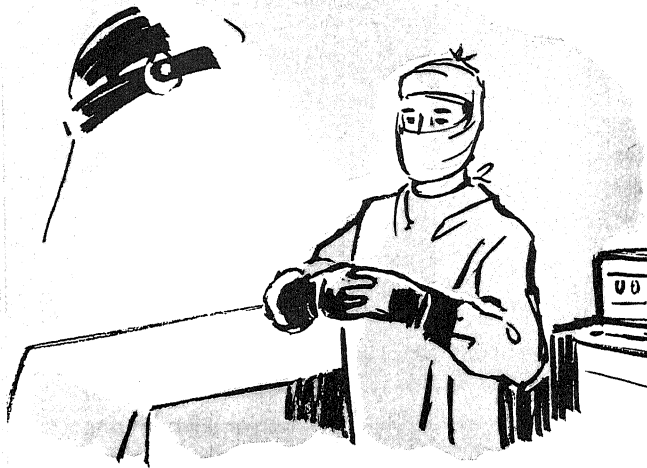
Rapid progress in stapedectomy keeps bringing changes in technique.

The operation on Mrs. James was performed, under local anesthesia, on her worse ear, in which her hearing became almost normal while she was on the operating table. Overjoyed, she was out of the hospital in two days. Some doctors keep their patients three days, or longer when there is dizziness (vertigo) following the operation. A general anesthetic is often used.

Mrs. James had been warned by her doctor that the immediate improvement on the operating table would be followed by temporarily poorer hearing for two weeks or a month, and that sometimes sounds are distorted for even longer. By the end of a month, her hearing was so much improved that she now plans to return for the same operation on the other side. Some surgeons prefer to wait a year or more before operating on the second ear, or prefer not to operate on the second ear.

The stapedectomy operation is now reported to benefit about 95 percent of suitable patients. But many years must pass before doctors can be sure that the improvement will last indefinitely. They recall that a different kind of operation, intended only to free the stapes, helped many persons, too, but that often the trouble returned.

Today, stapedectomy, the type of surgery done on Mrs. James, is the most commonly performed operation for otosclerosis. Earlier operations, still occasionally used, include mobilizing (freeing) the stapes, and *fenestration* (opening a new window between the middle and inner ear).



### Other types of surgery

Sometimes an infection of the middle ear has resulted in a perforated eardrum that will not close by itself, or in an eardrum covered with scar tissue. It may also have partly destroyed the little bones of the middle ear and done other damage. For such cases operations have been developed to reconstruct the drum and to clean out diseased tissue and partly reconstruct the middle ear in order to make a clear path to the oval window.

### Selecting a hearing aid

Richard Ward's otologist referred him to the same hearing center that had tested Mrs. James. The test showed that he, too, had a moderate loss, but there was one great difference: Mr. Ward, a mail carrier in his forties, had a sensori-neural impairment.

Since no strictly medical nor surgical treatment for this type of trouble has yet been found, except for a relatively few cases, the question became: Will a hearing aid help Mr. Ward, and if so, which one should he buy?

Sitting in the soundproof room, Mr. Ward listened to the otologist read off words, which reached him with great loudness. The purpose was to find out, first, how greatly speech had to be amplified

for him to hear it, and second, whether or not, when it had been amplified that much, he could understand what he heard.

Next he tried out a number of hearing aids, listening with each one to a list of words and repeating what he heard. At the end the audiologist wrote down for Mr. Ward the names and models of the three instruments that had helped him most.

Basic advances in physics, notably the vacuum tube and then the transistor, and numerous refinements in engineering have made the hearing aid a device so small that for many people it can be fitted into the temples of eyeglasses, or be worn in the ear or behind it, be hidden in a woman's hair, or masquerade as a tie clip or a brooch.

Authorities on hearing, however, lament the tendency of manufacturers to emphasize smallness of hearing aids, because many persons need the power that only a larger aid can supply.

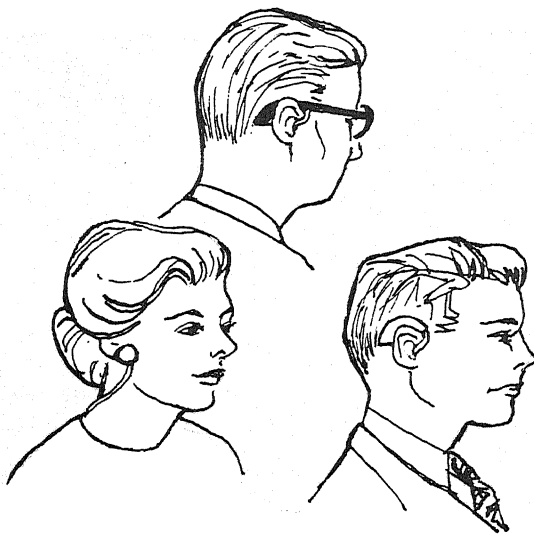
For unbiased help, consult an otologist or a hearing center that has most of the better hearing aids and can give you impartial advice. Such a hearing center or clinic is operated by a hospital, a university, a medical school, a Veterans Administration regional office (for veterans), or a local branch of the National Association of Hearing and Speech Agencies (formerly the American Hearing Society).

You may have to wait; you may have to travel to the nearest city; you may have to pay something. But you will learn whether or not a hearing aid can help you and which is the best for you.

Remember that it is important to have an examination by the family doctor or pediatrician and by an ear specialist, with such testing as the specialist recommends, before starting to select a hearing aid.

## **Using a hearing aid**

If you have had professional help in selecting a hearing aid which is right for you, wearing an aid eventually will seem as natural to you as wearing glasses. But it may bother you at first, and the world may seem terrifyingly noisy. Begin by wearing your



new aid only a few hours at a time and in your home.

Experiment for a while to find the adjustment that generally lets you hear best. After that, don't keep fiddling with the controls.

For the first time in years you may be able to hear a small child's voice, or catch the babble of a brook. But do not expect the aid to bring you perfect hearing or to help you hear what others cannot. You will have trouble following what's being said at a party, perhaps; so will others. And like everyone else, you'll be uncomfortable with a person who does not enunciate clearly or who talks with a cigarette in his mouth.

Some persons find they hear better with two hearing aids, which restore hearing to both ears. This can help in the location of the source of sound, just as vision in two eyes helps in seeing the exact location of an object.

A hearing aid is delicate: avoid leaving in direct sun, near radiators, or locked in a hot car. Read the booklet which the dealer furnishes with your particular hearing aid. In your daily inspection of your aid: free from ear wax, and the threatening to corrode the e sure it is not frayed. At ct the battery by removing y case.

## Speechreading and auditory training

Mrs. Laura Weaver hoped that with one of the new hearing aids she could keep her job as manager of a specialty shop. "I'm just not understanding my customers anymore," she told the audiologist.

The test showed that Mrs. Weaver had lost much of her ability to distinguish one word from another. Great amplification only made matters worse. "You'll be able to hear better with an instrument," the audiologist reported, "but your problem is to *understand* better, too. I think you should study speechreading."

Mrs. Weaver learned unusually rapidly. After less than ten hours of instruction in speechreading, often called lipreading, she could almost always "hear" people, provided she could see their faces.

A child or adult with a hearing loss uses speechreading, consciously or unconsciously, but training under a professional teacher brings added skill. Even people who cannot be helped by a hearing aid can nevertheless learn to "hear" with the eyes. And if a person hears some things with his ears but misses others, with or without a hearing aid, speechreading will help fill the gaps.



Ask your otologist or the hearing center about instruction in speechreading. Inquire, also, about classes in auditory training, which help people interpret sounds and use most advantageously whatever hearing remains. Our ability to hear, like any other ability, can be improved with practice.



## Manual communication, language of "signs"

If a deaf child or adult cannot learn speechreading (lipreading), he may be able to learn to communicate by fingerspelling and by the language of signs. This sometimes speeds up a deaf child's acquisition of language and may provide an impetus to learn to talk. Parents, friends, and job supervisors can learn "signs" to get ideas across to the deaf who know manual communication. In the "simultaneous method" the speaker talks and fingerspells or signs at the same time. This is faster than writing out ideas and messages on a blackboard or pad of paper.

However, some deaf children find "signs" as difficult to learn as speechreading, and other methods of communication must be tried. Relatively few children are purely deaf: many have other kinds of problems so that one method cannot answer all their needs.

## Other helpful devices

When a telephone call comes into the office of Ted Browning, a lawyer with an unusually severe hearing loss, both he and his secretary answer. The secretary repeats what the other person says, and Mr. Browning, having got the message by speechreading, replies directly to the caller.

Most hard-of-hearing persons, though, can readily follow telephone talk by using a telephone with a built-in amplifier, and many can do so simply by placing the receiver of an ordinary phone against their hearing aid. Several hearing aids have a specially designed "telephone pickup."

A telephone with an amplifier costs a little more than a regular telephone, but it looks the same and people with normal hearing can use it. To many a hard-of-hearing businessman, retired person, and teenager, it is a godsend. A few public telephones equipped with amplifiers can generally be found in large cities; the telephone company would know about them.

Portable amplifiers for use with telephones are now available from many hearing aid dealers.

Some also include which radio and tele-

vision stores, and sometimes hearing aid dealers, know about:

- An electronic device that flashes a light when the telephone or the doorbell rings or the baby cries.
- Headphones, with built-in volume controls, for listening to television, radio, and the phonograph. For this purpose the headphones generally give far better results than hearing aids.
- An inexpensive device called an "inductor," used with a hearing aid, which substantially improves the clarity of television, radio, and phonograph programs.
- Intercom systems that pick up sounds in one room, such as the baby's, and deliver them amplified to another, such as the kitchen or the bedroom.

### **"Cued speech"**

"Cued speech" is a combination of oral speech and simple correlated gestures identifying sounds only by groups. Thus the cues cannot be understood without seeing the lips, and the hands are in effect adding only the information missing from the lips. A great deal of interest in this method of communication has developed recently. Questions may be addressed to Cued Speech, Gallaudet College, Kendall Green, Washington, D.C. 20002.

## **RESEARCH provides hope**

The acute shortage of scientists who were prepared to conduct research in hearing disorders handicapped the research goals a few years ago. Aided since 1957 by training grants from NINDS, more investigators are qualified today; still more are receiving grants to prepare them for future research.

An important research field is epidemiology—the study of the behavior of an ailment in a population. To locate school children with hearing loss, NINDS supports a pilot study devoted to developing and verifying screening tests. Early results show that many children have a hearing defect and point to an acute need for greater refinements in current screening tests within the schools.

In laboratory research, some researchers are growing cells of ear bones through the tissue culture technique and observing changes. They hope to learn the cause of otosclerosis. One day it may be possible to prevent this common cause of hearing trouble.

Other scientists are studying the inner ear through microscopic and chemical analyses, and animal experimentation. They seek more precise information on how we hear and what goes wrong when a hearing loss develops. Eventually their work may show why hearing fades with age and suggest how such loss can be postponed or prevented.



### **Measuring electrical activity**

When hearing is normal, the louder the sound that enters the ear, the greater the electrical output of the sensory cells. One investigator, measuring this output in animals, has found evidence that the ear can recover spontaneously from a hearing loss caused by noise, provided the injury to the ear and the nerve of hearing has not been too severe.

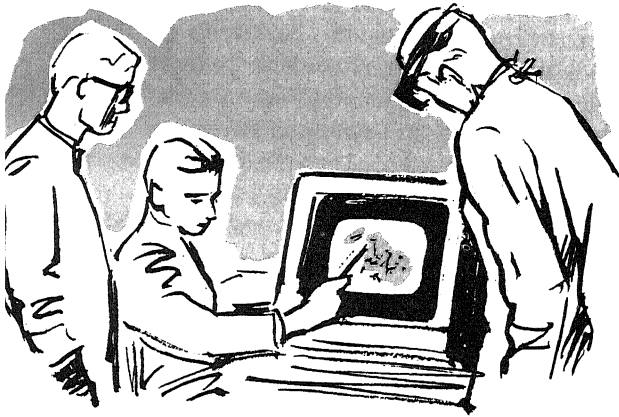
This confirms a common experience: noise can make you temporarily hard-of-hearing or deaf. If the process of recovering from temporary hearing loss can be explained, it may offer a clue to the treatment of some types of inner-ear trouble.

The measurement of electrical output is also being used by scientists, supported in part by an NINDS grant, to study especially puzzling cases of deafness

in children. In some of these children the electrical activity of the cochlea and the auditory nerve seems normal. Auditory signals apparently can get to the brain, but the brain for some reason does not respond.

Also, the EEG or electroencephalogram (a painless recording of the brain's own electrical waves) is proving increasingly useful in research on hearing.

An NINDS scientist discovered that the cochlear nerve is, surprisingly, a two-way path: it carries signals from the brain to the ear as well as from the ear to the brain. These outgoing fibers from the brain to the ear help the brain to regulate its sensitiveness to incoming sounds. Researchers have advanced the scientific knowledge on this two-way nerve path.



### Other research goals

Continued research will help answer the great need for:

- Tests that will more accurately determine where the hearing trouble lies.
- Aids that will enable people with even extremely little hearing to hear speech.
- Better ways of helping people with sensori-neural losses. Would an electronic device inserted against the partition between the middle and inner ear be helpful? Some researchers think so and are conducting experiments to find out.

- New light on defects that occur before and during birth. This is a goal of the collaborative project, mentioned earlier.
- More accurate information on the extent of the problem of hearing impairment. This is being supplied by a study of hearing losses among industrial workers and a national survey of hearing problems in children—projects directed by the American Academy of Ophthalmology and Otolaryngology and supported by NINDS.

### Ear banks

Much of our information about the causes of hearing loss has been gained through the study of middle-ear and inner-ear structures after death. In persons whose hearing loss followed mumps, for example, these studies have shown that the virus responsible for the disease had destroyed parts of the cochlea having to do with the blood supply. Where the loss followed measles, the virus had destroyed sensory cells. After-death studies are essential because the inner ear cannot be examined during life.

To further this research, a network of Temporal Bone Banks (often called "ear banks" because the temporal bones contain the middle-ear and inner-ear structures) has been set up in leading medical centers and universities throughout the country. The banks are actually laboratories, enabling scientists to learn more about the causes of hearing loss and thus to develop more effective methods of prevention and treatment.



The Temporal Bone Banks Program is sponsored by the Deafness Research Foundation and the American Academy of Ophthalmology and Otolaryngology. The program provides a channel through which a person with impaired hearing can help future generations by bequeathing his temporal bones for scientific study. For further information, talk to your ear specialist or write to The Deafness Research Foundation, 366 Madison Avenue, New York, N.Y., 10017, which aids all major areas of ear research.

### **For relatives and friends**

Remember that a hearing loss can affect the ability to locate sound, to separate speech from noise, and—because sounds may be distorted—to understand speech. As one authority puts it, a hearing loss does not strike the ear alone; it affects the entire person.

If you have a hard-of-hearing relative or friend, don't start talking to him until he can see you. Try to place yourself where the light falls on your face. Speak distinctly rather than loudly.

If he is having difficulty understanding you, slow up. If he misses an important word, use a different word that means the same, and put it in a phrase or a sentence; groups of words are much easier to grasp than one alone.

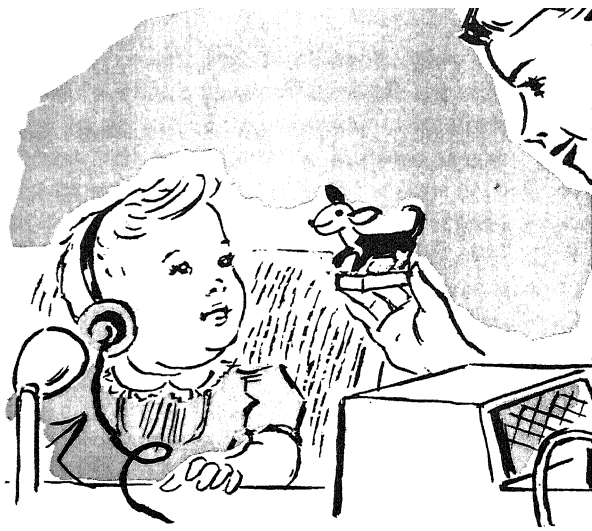
If several people are talking and he seems lost, fill him in: "We're talking about Susan's work," or "Ed's boy is going back to school." Just a few words will help tremendously by giving him an idea of what to look and listen for.

Your otologist and the hearing clinic or center can give you other tips to ease his way and yours, too.

### **Where to go for help**

Good hearing, or the most suitable substitute, makes life easier in school, in earning a living, in having fun, and in staying in touch with family and friends. Because the person with a serious hearing handicap has a major problem throughout life, delay in discovery and treatment of hearing difficulties is dangerous.

At the first suspicion of trouble with hearing in



yourself or some member of your family, see your family doctor and ask him to refer you to an otologist.

If there is something wrong that cannot be corrected, ask the otologist to suggest a hearing clinic or center. A variety of community agencies can help. Among these are clinics or centers connected with hospitals, medical schools, universities, and schools for the deaf, or operated by local branches of the National Association of Hearing and Speech Agencies.

Your local or State health department may be able to tell you about local or nearby services for persons with impaired hearing.

In many States, the public schools have programs to help children with hearing and speech problems. Your local school system or your State Department of Education can supply information on these programs. The Department of Health, Education, and Welfare's Office of Education conducts a grant program for the training of teachers of the deaf, and offers consultation services on school programs for the hearing handicapped.

Through State crippled children's and maternal and child health programs, the Department of Health, Education, and Welfare's Children's Bureau gives basic support for hearing services to children in most States. These programs are designed for children of families in every economic level. The Bureau provides

services to mothers and infants with a possible or confirmed hearing loss through the Maternity and Infant Care Projects, and to preschool and school age children, and through the Children and Youth Projects.

You can get names and addresses of hearing and speech centers nearest you and buy helpful publications from the National Association of Hearing and Speech Agencies, 919 18th Street NW., Washington, D.C., 20006, or the American Speech and Hearing Association, 9030 Old Georgetown Road, Bethesda, Maryland, 20014.

You can obtain free lists of pamphlets and books on speechreading, speech and auditory training, and education of the deaf for professional or lay readers, and buy those desired from the Alexander Graham Bell Association for the Deaf, with headquarters at the Volta Bureau, 1537 35th Street NW., Washington, D.C. 20007. The Association has more than 200 parent groups affiliated with it throughout the country and publishes the lay and professional journal, *The Volta Review*. *Speaking Out* is a newsletter especially written for parents which goes to all affiliated parent groups each month.

You can buy back issues of *American Annals of the Deaf* from Gallaudet College, Washington, D.C., 20002. Gallaudet can send you a free catalog of books and a free newsletter for those interested in the welfare of the deaf. The College sells about 150 different pamphlets. These materials discuss many problems concerned with hearing loss, including problems of hearing-handicapped children.

The National Association of the Deaf, 905 Bonifant Street, Silver Spring, Md. 20910, offers a free catalog of materials relating to education and problems of the deaf of all ages. It also publishes the *Deaf American*, a monthly magazine for both laymen and professionals who are concerned with deafness. This unique organization of the deaf, parents of the deaf, and professionals in the field has State associations in most parts of the United States.

Your State's chapter of the National Easter Seal Society for Crippled Children and Adults (the Easter Seal Society), 2023 West Ogden Avenue, Chicago,



Illinois, 60612, may have a program to help people with a hearing loss. Write them for information services to the hearing handicapped that are available in their research and treatment centers, speech center itinerant programs, or in their summer camps. The Easter Seal Society also publishes a directory of camps for the handicapped which lists camps specifically for the deaf and hard of hearing by geographic location.

Schools and classes for deaf and hard-of-hearing children are listed yearly in *American Annals of the Deaf*. The Volta Bureau has lists of preschool classes, and summer courses in hearing, speech, and education of the deaf.

The John Tracy Clinic, 806 West Adams Boulevard, Los Angeles, California, 90007, offers a training course by correspondence to the parents of young children who are deafened or have a hearing loss. The course is free.

The Federal-State program of vocational rehabilitation can help persons with impaired hearing to prepare to get a job and hold it. Write to the director of the State Vocational Rehabilitation Agency in the capital of your State.

Every veteran with a hearing loss incurred during military service is entitled to assistance from the Veterans Administration.

Advice on the risk of having a child with inherited deafness can be obtained at a genetics counseling center. A list of such centers appears on page two of "Counseling in Medical Genetics," by Sheldon R. Ph. D., Philadelphia, Saunders, 1963. Your doctor may know of one in your area.

Never before has the person with partial or complete loss of hearing had so many possible sources of help. Help often will not come to him; he must seek it, with much to gain from expert assistance. More than this, investigators carry on persistent, imaginative research for new ways to prevent hearing impairment and to treat it.

Further information on some rarer causes of hearing loss appears in: DIZZINESS, including MENIERE'S DISEASE, Hope through Research, Public Health Service Publication No. 1651. Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. (20 cents; \$15 per 100.)

